FIELD GUIDEBOOK

to

ENVIRONMENTS OF COAL FORMATION IN SOUTHERN FLORIDA

Trip Leaders
William Spackman
David W. Scholl and William H. Taft

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STOP 2: Cypress Head

Objectives:

A. Inspection of typical cypress hammock, cypress surface litter and cypress hammock peat.

B. Discussion of hammock types, hammock origin and hammock maintenance.

C. Inspection of "algal mat" in the open marsh and discussion of its possible role in the development of sediments.

D. Discussion of element concentration and palynology of cypress hammock peat.

Discussion:

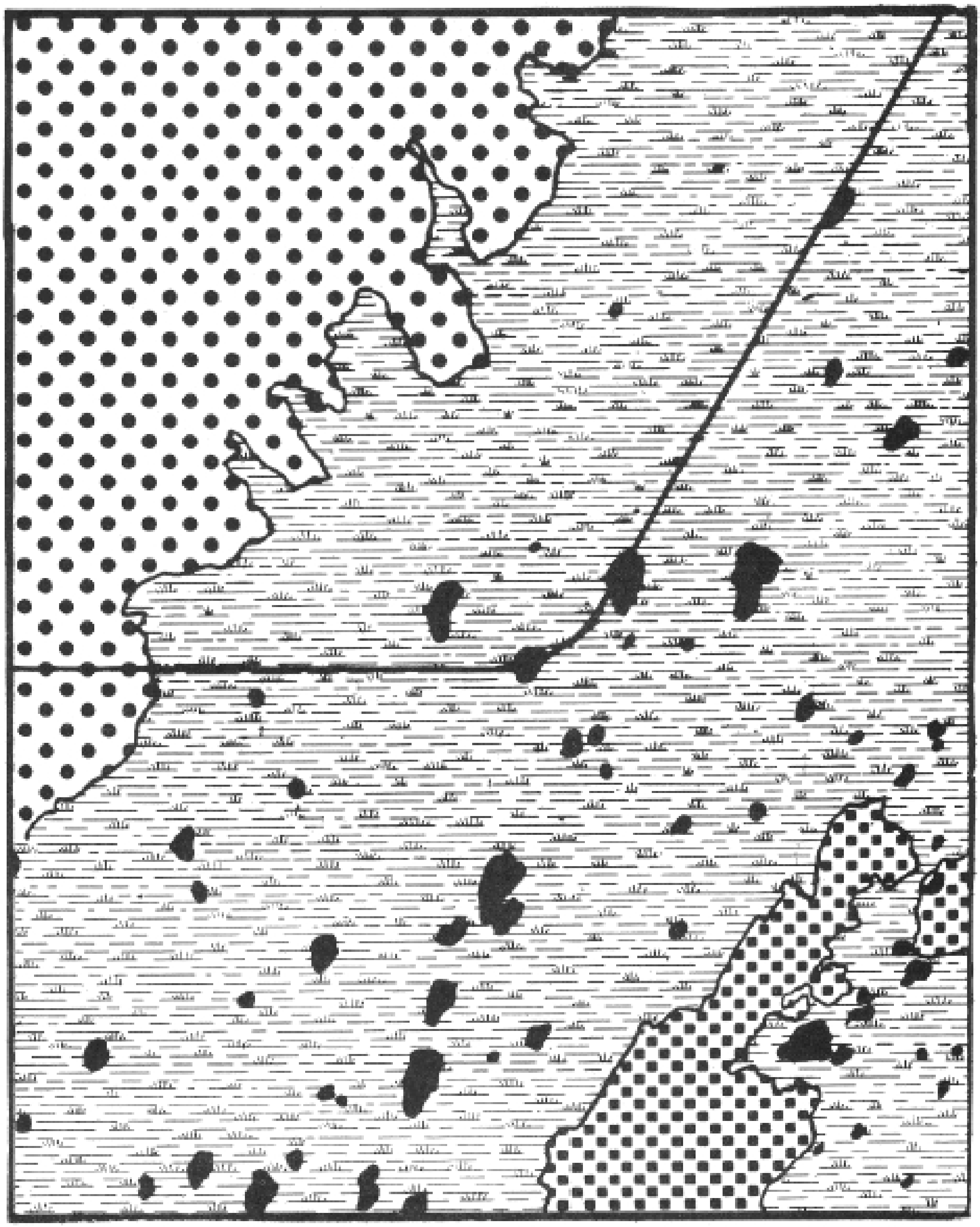
The "Everglades" region of southern Florida occupies an area of at least two and one-half million acres. Prior to institution of extensive drainage programs in the 1930's and 1940's, most of this area was under water for a large part of the year. As the result of the construction of drainage canals, hundreds of thousands of acres south of Lake Okeechobee have been "reclaimed" for agricultural purposes.

The Everglades consist of herb covered marshes and forested swamps with the marsh environments occupying the greater area. Typically they consist of a "saw grass" plain in which a sedge (*Mariscus*) rather than a true grass dominates the environment. Usually this sedge is so abundant that casual inspection leaves one with the impression that it is the only plant species present in the open marsh. This saw grass plain is interrupted by the presence of relatively small forested areas that are usually either elliptical, round, or tear-drop shape in plan. These are often called "tree islands" because they appear to be island-like masses in the open marsh. They are also referred to as "heads", presumably because of the dome-shaped profile that some of them exhibit. The term "hammock" is also applied to them; this word is of obscure origin but probably is simply a variation of "hummock", the latter being of unknown derivation and meaning a low ridge, mound, or pile of material. Although they may begin in small depressions, the tree islands soon develop into "low mounds" of peat. If the hammock site was initially a bedrock high, the "low mound" may be formed largely of humus. By virtue of their elevation, the hammocks represent environments in which hardwood tree species can successfully compete with the sedges that dominate the slightly lower adjacent areas. In favorable sites the arborescent hammock cover develops into a complex plant community in which the gumbo limbo (*Bursera simaruba* L.), royal palm [*Roystonea regia* (H.B.K.) O.F. Cook], mahogany (*Swietenia mahogani* Jacq.), strangler fig (*Ficus aurea*, Nutt.) and other "dry" habitat species flourish. Some of the larger and higher hammocks support a particularly complex, sub-tropical vegetation and it has been suggested that the term "hammock" be restricted for use in describing such sites. For present purposes, it will be more useful to regard all small, isolated areas of arborescent or shrubby vegetation that are surrounded by saw grass marsh or its equivalent as "hammocks". These appear to pass through several developmental stages, if undistrubed, and ultimately result in the development of the complex forest that is the successional climax under the present climatic regime.

Plates I and II show the hammock - marsh relationship, the latter plate showing a "young" hammock that has reached the "bay head" stage of development and that has been modified vegetationally as the result of fire. The latter is evident from the abundance of saw palmetto [*Serenoa repens* (Bartr.)Small] which is said to be a fire-resistant species.

In the area surrounding Stop 1, the hammocks tend to have a tear-drop shape with a truncated leading margin. The environments present are represented in Figure 4. Most of the hammocks in this vicinity are in what might be termed a "late cypress" stage of development. They appear to have developed beyond the stage in which cypress is the only tree species present and now include a number of hardwood species, notably the coco plum (*Chrysobalanus icacao* L.) and pond apple (*Annona glabra* L.). Typically the hardwoods take root on the mounds created by old cypress stumps. As more and more organic material accumulates on the hammock floor, the area of open water is gradually diminished and hardwood seedlings begin to develop in areas unassociated with cypress stumps. Gradually the cypress is eliminated from the central areas of the hammock and flourishes only on the perimeter where an open water site is still

PLATE II



LEGEND ½ mile

HAMMOCKS

MARSH

HAMMOCK SWALE

CYPRESS SLOUGH

MAP OF ENVIRONMENTS IN THE CYPRESS HEAD AREA

Figure 4

available. Thus, the cypress hammock develops into a tree island covered with a mixed hardwood vegetation often dominated by "bay" trees and hence, called a "bay head".

The origin of the hammocks in the Everglades has never been satisfactorily explained. Even more difficult to understand is the mechanism that has served to restrict their size and shape. It has been suggested that fire creates a site suitable for the initial development of a hammock by killing the saw grass but leaving little clumps or hummocks on which the arborescent species can root and grow before the saw grass repopulates the site. Frequent fires have also been suggested as the mechanism for maintaining the hammocks as comparatively small "islands". Presumably this would be accomplished either by the complete destruction of the hammocks prior to their achieving any appreciable size or by restricting their expansion by frequent partial burning.

Some hammocks appear to develop on areas in which the bedrock forms a topographic high, some appear to have been developed in areas in which the bedrock surface was topographically low, and still others seem to bear no particular relationship to the topography of the bedrock. It might be argued that this suggests a "chance" origin, as the result of the successful germination of hardwood seeds on randomly located sites. Some may, in fact, have originated in this manner, but most hammocks thus far inspected show evidence of origin on either a topographically low or high site. Both of these conditions create situations in which the saw grass is no longer the most effective competitor. In the "deep" water sites the cypress can colonize the area and initiate hammock development. In the "dry" sites the hardwoods can immediately occupy the area and initiate hammock formation.

With respect to vegetative cover, several different hammock classes exist. Although certain of these grade compositionally into one another, it is useful to consider each as a hammock "type". The more important types are:

1. The Cypress Hammock
2. The Bay Tree Hammock
3. The Mahogany Hammock

4. The Palm Hammock
5. The Shrub Coppice Hammock

The shape of the hammocks appears to be influenced by the direction and rate of surficial water flow. The circular form is most common in areas characterized by low rates of surface water flow and the elongate forms seem to be restricted to the "slough" areas where surface flow is great. The truncation of the more northerly ends of many of the hammocks in the area of Stop 2 is, at the moment, unexplained.

The hammock at Stop 2 exhibits the dome-shaped profile that some of the cypress heads show when viewed from a particular angle (see Plate III). This is presumably related to the age of the trees and the center of origin of the hammock. The cypress common in this area has been designated pond cypress (Taxodium ascendens Brong.) by some authors. This species is said to differ from the bald cypress (Taxodium distichum) in that the leaves are borne appressed to the stem axis as opposed to being borne in a plane with each leaf projecting out from the axis at a more or less right angle. It is also said to be smaller and to possess a smoother bark. Examination of a few of the trees near the margin of the hammock is likely to reveal the presence of both types of leaf arrangement, suggesting the presence of both species. Further inspection may reveal both types of leaf arrangement on the same plant. This could represent hybridization, however, most of the botanists who have observed this situation have concluded that the cypress present here is Taxodium distichum (L.) L.C. Rich and that the appressed leaf condition and other characteristics are merely features of a growth form related to the fact that these trees are growing on relatively "poor" sites under rigorous edaphic conditions.

The interior of the hammock is more "open" than many other hammock types. In the open water areas, cypress "knees" are well developed (Plate III). Old stumps are common in the interior, although often reduced to a pile of brownish organic debris. Hardwoods have taken root on many of these mounds and in certain areas the hammock is relatively dry with hardwoods dominating the scene. In the cypress areas the peat is granular in texture, very non-coherent by virtue of the quantity of

a

b

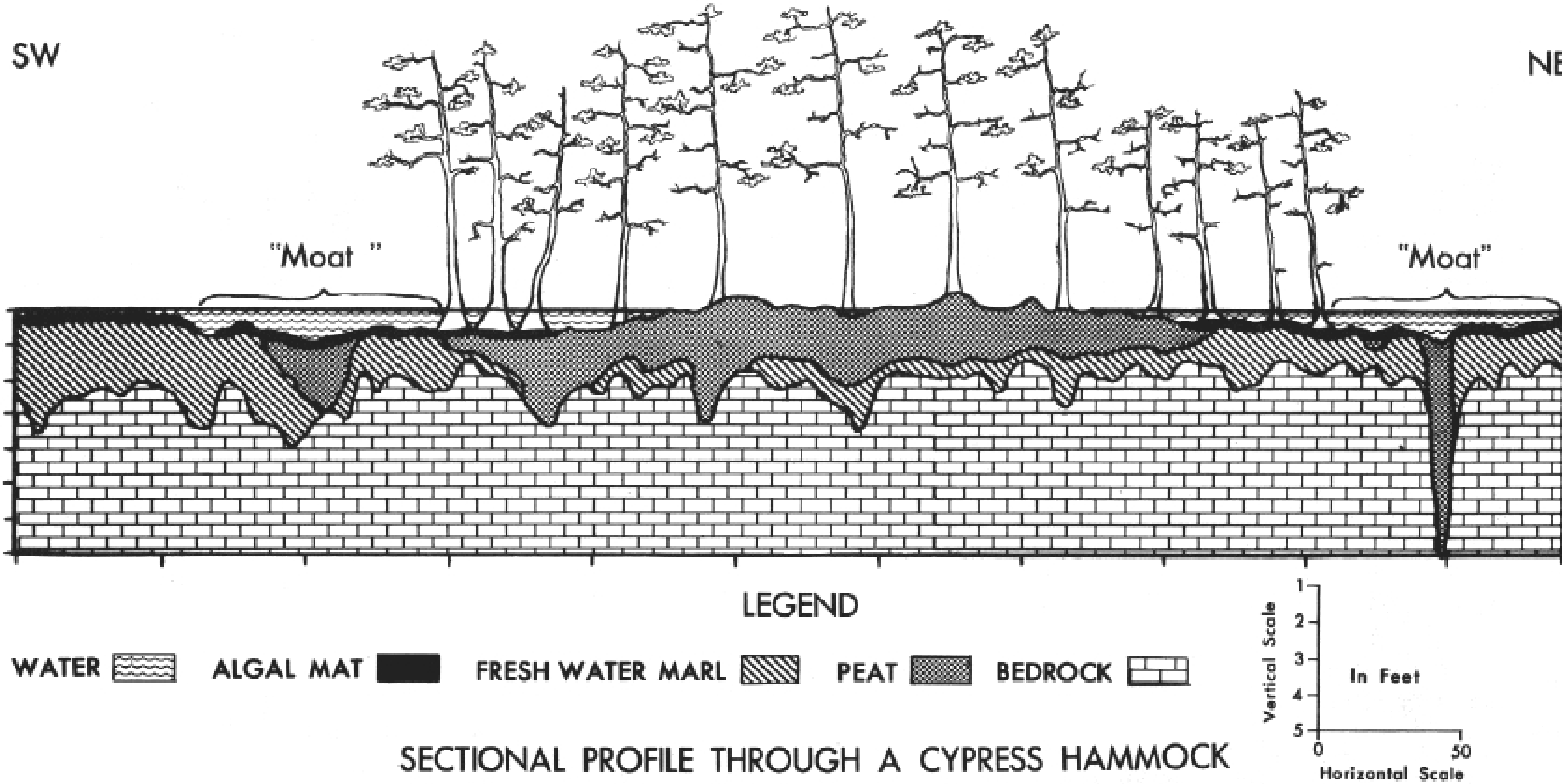
c

PLATE III

water present and it seldom contains large pieces of woody material that one might expect to find in view of the well-known resistance of cypress to decay organisms.

In section, the hammock at Stop 2 is of interest because the marl that blankets the adjacent marshland extends beneath the hammock peat, indicating a period of marl formation prior to onset of hammock development (see Figure 5). In some of the deeper depressions underlying the hammock, the marl is absent, perhaps because of non-deposition or perhaps because of solution of the lime sediments as the result of the new set of geochemical conditions introduced by the initiation and continuation of peat accumulation. Craighead's observations have led him to suggest that marl is being removed by solution in areas of active peat accumulation. Such solution effects may extend into the bedrock, thus providing a mechanism that tends to insure subsidence and continued peat accumulation.

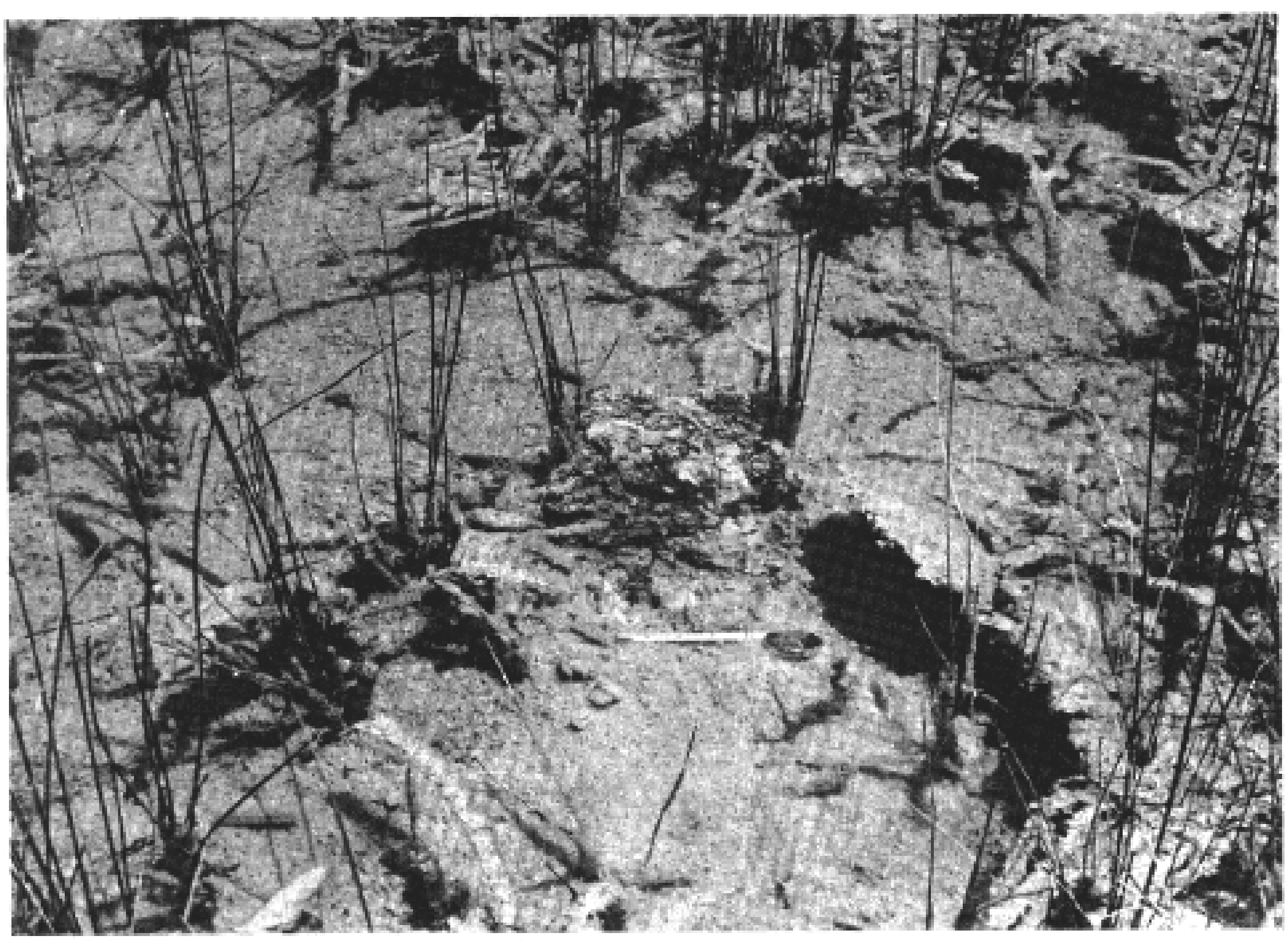
The origin of the sub-peat marl and the surficial marl found in the open marsh appears to be related to the occurrence of what is loosely termed an "algal mat". This mat is found in areas in which the saw grass forms a sparse stand or in marsh areas in which the spike rush , Eleocharis spp.,forms the vegetative cover. In general, these sites appear to be areas of somewhat deeper water and the "algal mat" develops on the ground surface between the herbaceous plants and actually clothes the sub-aqueous portions of the sedge or rush leaves (see Plate IV). The mat is composed of a complex mixture of filamentous and colonial algae, diatoms, and bacteria plus entrapped organic and inorganic debris. It is commonly an inch or more in thickness, where it occurs on the sub-aqueous ground surface. Platelets of the mat are commonly observed, partially afloat, with a section of the plate still attached to the main mat that rests on the marl surface. The invariable association of mat and marl suggests the possibility of a genetic relationship. It would seem that the calcium contained in the surficial water could be readily precipitated, either by lime secreting algae or by the combined effect of all plants present on the carbon dioxide content of the flowing surface water.



SECTIONAL PROFILE THROUGH A CYPRESS HAMMOCK

Figure 5

a



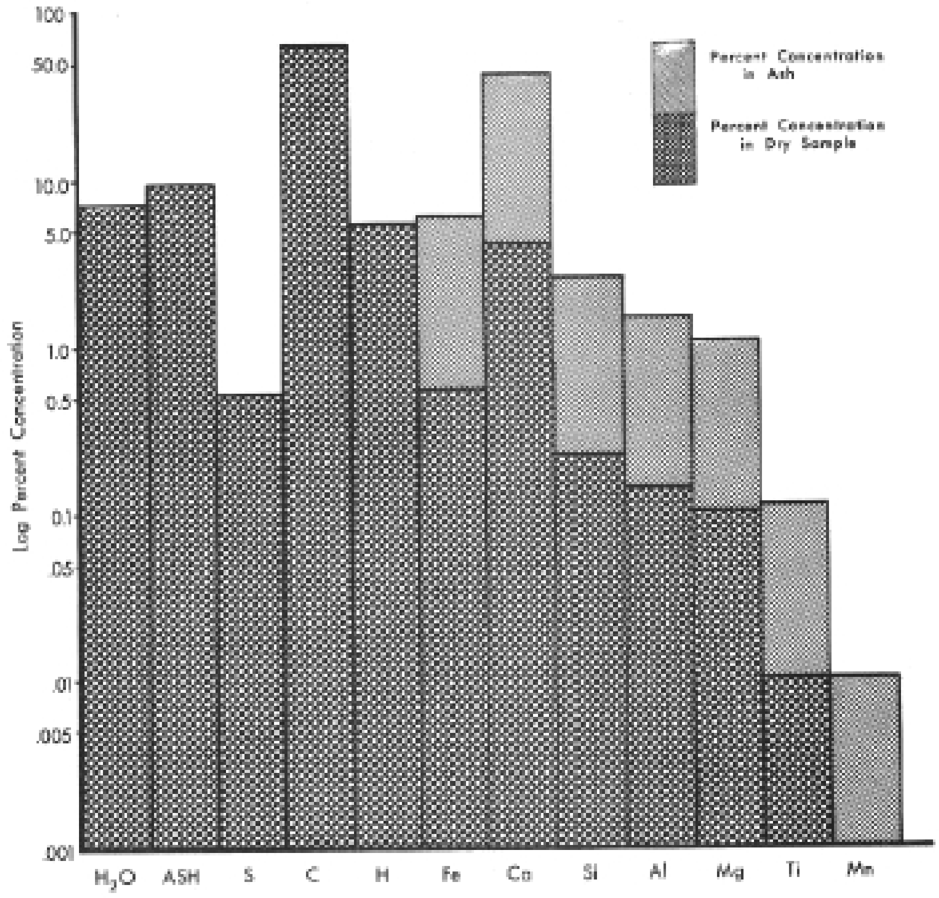
b

PLATE IV

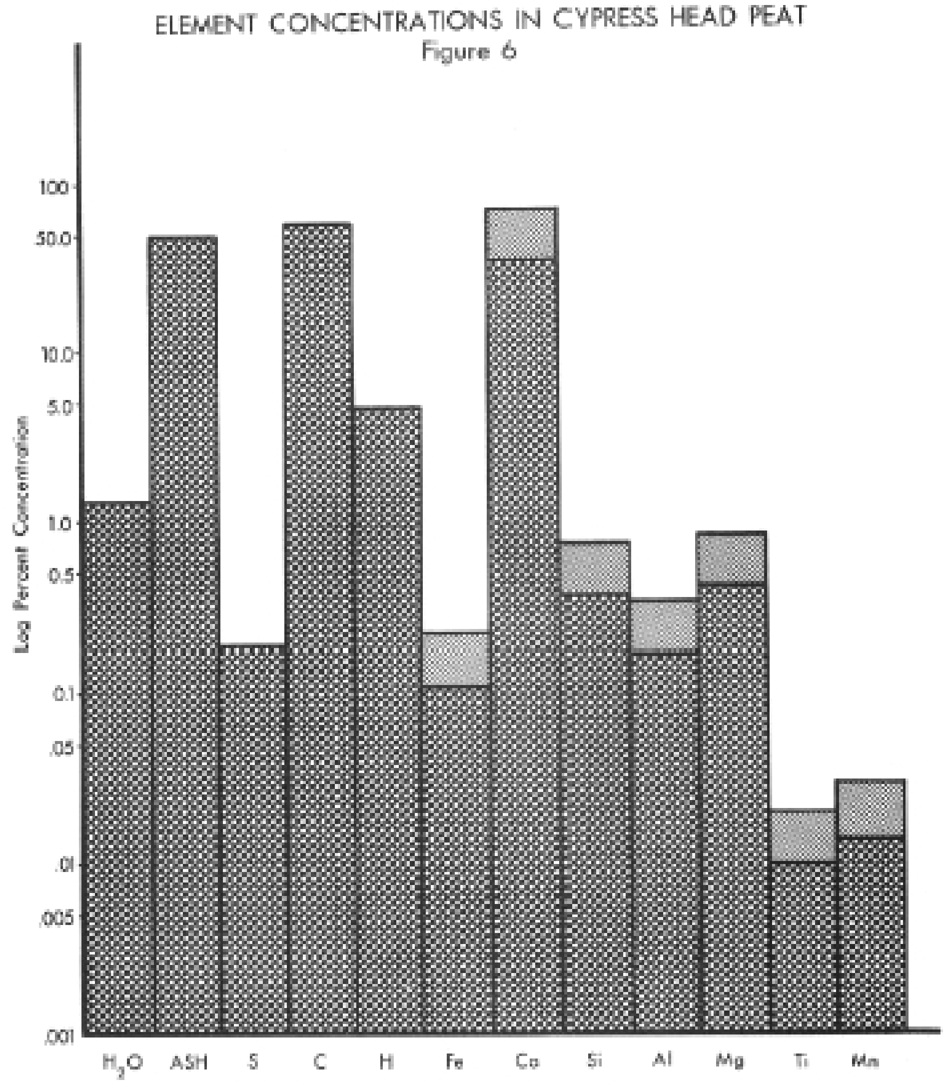
The algal mat may also effect the concentration of manganese, as the data thus far collected suggest a higher concentration in the mat than is present in many of the peat types. Figures 6 and 7 provide an opportunity to compare the concentrations of various elements encountered in the cypress peat with those encountered in the algal mat. The high calcium content and correspondingly high ash yield in the case of the mat suggests that calcium carbonate precipitation may proceed within the mat itself.

The pollens contained in cypress hammock peat are derived from a sizeable number of different plant species. Several of these do not participate in the formation of the vegetative cover of the hammocks. This is, of course, not surprising for the hammocks represent a minor fraction of the area involved in any given square mile. The latter fact might suggest that the pollen content of the cypress peat would reflect the areal dominance of the saw grass marsh to such an extent that it would mask the presence of any distinctive hammock pollen assemblage. In utilizing pollen and spores in stratigraphic work, it is often emphasized that the great value of these fossils is related to the fact that they are wind disseminated and hence transgress local environmental boundaries. In view of this, it is argued that time equivalent assemblages are readily recognized and the confusing effects of environmental changes at any one time horizon are minimized. There is no question of the validity of this argument. However, it is equally useful to emphasize that if the pollen and spore assemblages are examined more critically, both age and environmental setting are often detectable. The extent to which environment can be interpreted will become evident to some degree as the pollen assemblages encountered at the various sites are examined.

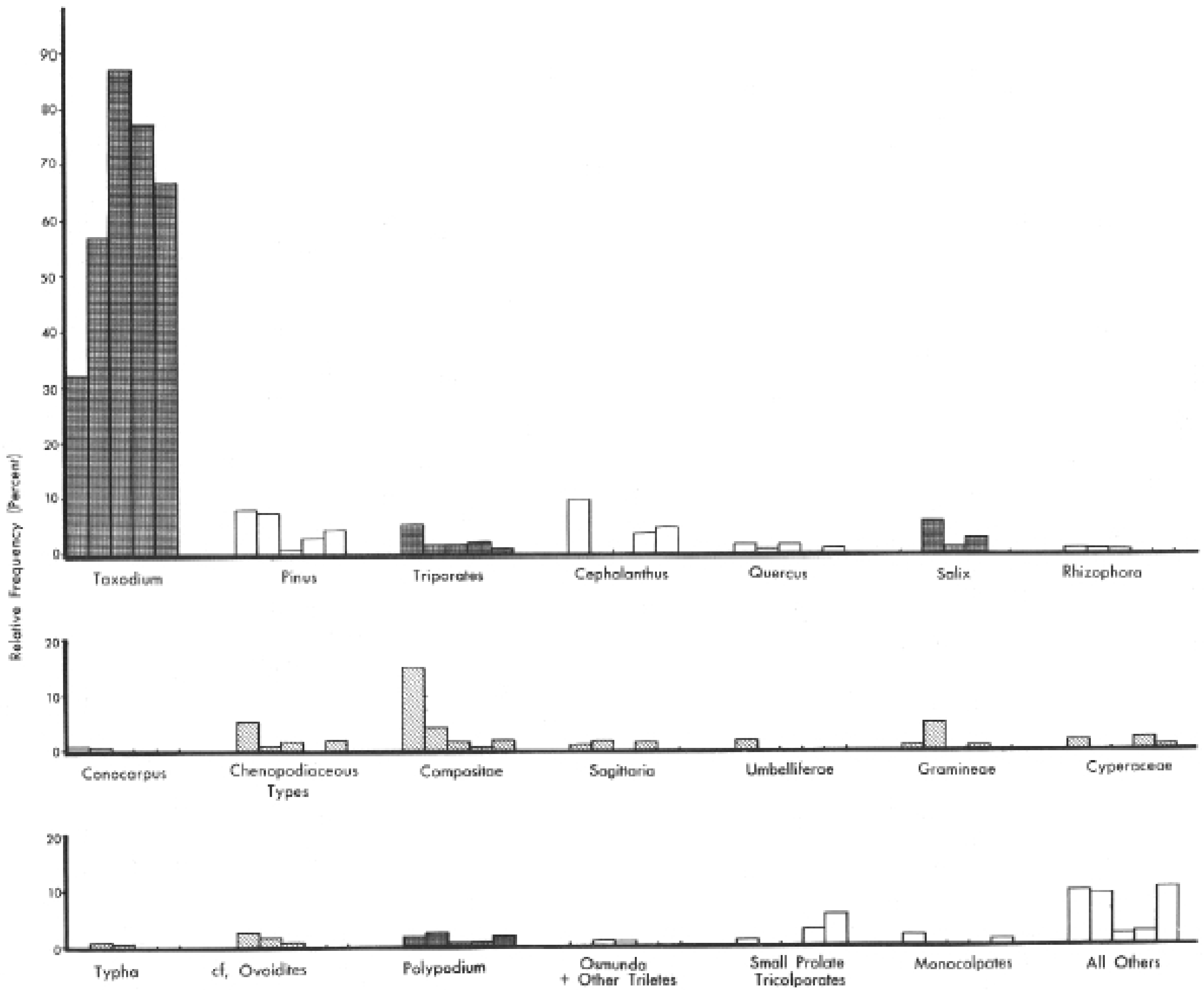
The pollen and spore assemblage contained in the cypress hammock peat (Figure 8) renders this environment recognizable, and readily distinguished from any others in the area. This does not mean that each species in the plant cover is represented in direct proportion to the frequency with which their individual plants occur, but it does mean that this plant community yields a characteristic assemblage of preserved



ELEMENT CONCENTRATIONS IN CYPRESS HEAD PEAT
Figure 6



ELEMENT CONCENTRATION IN "ALGAL MAT"
Figure 7



POLLEN AND SPORE CONTENT OF FIVE CYPRESS HAMMOCKS
Figure 8

pollen and spore materials. Certain species in the plant cover are not represented in the sediment by preserved pollen grains, others are over-represented. Accordingly, the plant community, and hence the environment in question, leaves a unique pollen "signature" in the fossil record. It is in connection with the interpretation of these signatures that the palynologist ceases to be a technician and must become a botanist.

In addition to providing a basis for distinguishing the cypress hammock environment from other environments, the pollen and spores may also provide a clue as to the stage of development reached by the vegetation in the cypress hammock - bay head hammock succession. If this is confirmed by the collection and analysis of additional data, it will demonstrate the extent to which precise reconstructions of past environments can be made once the required information is amassed through the study of modern sediment - environment - vegetational relationships.

STOP 3: Bay Head

Objectives:

A. Inspection of a Bay Tree Hammock.

B. Comparison of cypress hammock surface litter and peat with bay head surface litter and peat.

C. Discussion of sectional profiles through hammocks.

D. Discussion of the role of cypress and mangrove in colonizing marshland areas.

Discussion:

Bay tree hammocks in the Shark River Slough area are known to be underlain by as much as 14 feet of peat. Such hammocks are surrounded by a saw grass marsh underlain by three to five feet of saw grass peat. Ideally, they should be inspected but their inaccessibility makes this impractical. The hammock at Stop 3 is reasonably similar and is typical of the bay heads east of the Slough area. It differs from some of the Slough hammocks in that a thick peat layer has not been developed beneath it and it is not surrounded by saw grass peat. Figure 9 shows that the hammock lies in a vast marshland area that is interrupted to the north by small outliers of the Miami Rock Rim (the Pineland environment). No